



Checklist of the flora of the restingas of Piauí state, Northeast Brazil

Francisco Soares Santos-Filho^{1*}, Eduardo Bezerra de Almeida Jr.², Patrícia Barbosa Lima³ and Caio Jefiter dos Reis Santos Soares⁴

1 Universidade Estadual do Piauí, Campus Poeta Torquato Neto, Centro de Ciências da Natureza, Rua João Cabral, 2231, Setor 17, CEP: 64002-200 Teresina, PI, Brazil

2 Universidade Federal do Maranhão, Departamento de Biologia, Av. dos Portugueses, s/n, Bairro Bacanga, CEP: 65085-580 São Luís, MA, Brazil

3 Universidade Federal Rural de Pernambuco, Rua Dom Manoel de Medeiros, s/nº, CEP: 52171-900 Recife, PE, Brazil

4 Universidade Estadual de Campinas, Instituto de Biologia, Cidade Universitária Zeferino Vaz, Rua Monteiro Lobato, 255, CEP: 13083-862, Campinas, SP, Brazil

* Corresponding author. E-mail: fsoaresfilho@gmail.com

Abstract: Sandy coastal plain vegetation (*Restinga*) is composed of communities of plants that grow on Quaternary Neosols along the entire extension of the Brazilian coast. The state of Piauí has a coastal extension of 66 km and is entirely located in the semi-arid zone of Northeastern Brazil. This study catalogued the phanerogam species found along the coast of the state of Piauí, the data of which was compiled from surveys in online databases and literature, and herbarium collections. A total of 363 species distributed among 235 genera, and 74 families were identified. The families with the greatest number of species included Fabaceae (108 species), Euphorbiaceae (19), Amaranthaceae (13), Apocynaceae (12), Cyperaceae (12), Rubiaceae (12), Bignoniaceae (11), Malvaceae (11) and Poaceae (11) and represent over 57.6% of the species collected. Approximately 87% of the species were common to other restinga areas in Northeastern Brazil, and ca. 13% were restricted to the coast of the state of Piauí.

Key words: restinga vegetation, coastal vegetation, herbarium, Northeastern Brazil, Quaternary Neosols

INTRODUCTION

The restinga is an ecosystem associated with the Atlantic Forest (Scarano 2002) that shows extreme fragility because of its long occupation and human interference or increasing predation, in which degradation has been intensified by predatory human activity (Rocha et al. 2004; Santos-Filho et al. 2013).

In addition to being highly degraded, this ecosystem is recognized for presenting itself as an environment that is in the process of ecological succession because of

its recent establishment during the Quaternary period (Zaluar and Scarano 2000; Santos-Filho et al. 2013). It is believed that species that colonized the restingas originated in the Atlantic forest or other adjacent ecosystems (Rizzini 1997; Araujo 2000; Scarano 2002) but adjusted to the new environmental conditions in the restingas.

Because soil and climatic conditions are the most influential factors for successfully establishing plant communities (Mather and Yoshioka 1968; Araújo et al. 2004), knowing which species are present and how these species are distributed along the Brazilian coast become important for better understanding the dynamics of restingas because such environments typically have poor soil with high salinity (Hay et al. 1981).

Among the Northeastern states, more floristic and structural studies of restinga ecosystems have been undertaken in Pernambuco, Piauí, Bahia, Paraíba and Rio Grande do Norte. In Pernambuco (Zickel et al. 2007) and Ceará (Santos-Filho et al. 2011), studies have provided catalogued the flora in their restingas through the compilation of species records for those that occur in this ecosystem.

Studies aimed at recognizing the species composition of coastal forests have proven to be essential in face of the constant threat of the eradication of these environments due to the rapid degradation and loss of habitat (Rocha et al. 2007), which could trigger the loss of biodiversity and the loss of endemic species in more severe cases (Silva and Tabarelli 2000).

Therefore, the compilation of records of punctual species from floristic inventories and herbarium collections makes it possible to understand the history of species that existed and were no longer collected either by lower collecting efforts or species extinction (Almeida Jr. et al.

2012). These data are important because they generate information about the biodiversity and conservation status of restinga areas.

The state of Piauí has 66 km of coastline that is predominantly composed of sea cliffs of the Barreiras Formation and quaternary quartz sand deposits. Restinga vegetation occupying dunes and inter-dune regions can be found along the entire coast of that state and can have different physiognomies that vary from grassy fields to shrublands or forests and grassy fields with “carnaubais” (*Copernicia prunifera*) (Santos-Filho et al. 2010).

Even with a small coastline, few studies have been conducted on the coast of Piauí including only two scientific (Santos-Filho et al. 2013; Santos-Filho and Zickel 2013) and one technical study (Fernandes et al. 1996) that has been published with data referring to the restinga vegetation in Piauí. In an effort to fill this lacuna, this study provides a catalog of the phanerogams registered in the restinga areas of Piauí state, Brazil.

MATERIALS AND METHODS

The state of Piauí has a total territorial area of 251.529 km², making it the third largest state in Northeastern Brazil (Figure 1). In addition to the Restinga, the vegetation cover of this area also includes a vegetation mosaic ecotone consisting of Cerrado, Caatinga and Cerrado-Caatinga transitions (Farias and Castro 2004). According to the classification proposed by Velloso et al. (2002), *Caatinga* occurs in the state in the “Depressão Sertaneja Setentrional” region and the “Campo Maior” and “Ibiapaba-Araripe” complexes.

The species listed in this study were compiled from data available at HAF, IPA, PEUFR and TEPB (acronyms according to Thiers 2014) and from floristic surveys performed in the Delta do Parnaíba Environmental Protection Area (Fernandes et al. 1996; Santos-Filho et al. 2013). All herbarium specimens were considered, including invasive species that grow in lacustrine environments and species typical of areas in contact with mangrove swamps and exotic species. Plants with incomplete or

questionable identification were excluded.

The herbarium survey covered plants collected in the territory of the four cities of Piauí state’s coast (Ilha Grande, Parnaíba, Luiz Correia and Cajueiro da Praia), which are all located in coastal plains with neosols predominantly quaternary or Barreiras Formation (Santos-Filho 2009).

The catalog lists the botanical families and species in alphabetical order. The classification system used was based on APG III (2009). Current species names were confirmed by consulting the MOBOT database (2012), “Flora do Brasil” list (2014) and specialized literature for certain groups. The biological forms of species were identified based on the classification system of Whittaker (1975), and information on the life forms was obtained from herbarium labels.

RESULTS

The final list of phanerogam species reported for restinga areas in the state of Piauí totaled 363 species distributed among 235 genera and 74 families (Table 1).

The families with the greatest number of species included the following: Fabaceae (108), Euphorbiaceae (19), Amaranthaceae (13), Apocynaceae (12), Cyperaceae (12), Rubiaceae (12), Bignoniaceae (11), Malvaceae (12) and Poaceae (11), which corresponds to 57.6% of the total number of species. Approximately 40.5% of the families were represented by only one species.

The most representative genera in this survey were *Mimosa* (11 spp.), *Aeschynomene* (7), *Senna* (7), *Alternanthera* (6), *Croton* (6), *Byrsonima* (5), *Chamaecrista* (5), *Bauhinia* (4), *Combretum* (4), *Copaifera* (4), *Cyperus* (4), *Ipomoea* (4), *Passiflora* (4) and *Solanum* (4), together representing 20.7% of all of the species recorded.

This study demonstrates that among the species surveyed, 102 (28%) were herbaceous, 92 (25.3%) were shrubs, 76 (20.9%) were trees, 49 (13.4%) were vines, 40 (11%) were subshrub, and 4 (1.1%) had hemiparasitic habit (Figure 2). Thus, our survey indicated that 39% of the species observed in the coastal areas of the state of Piauí were either herbaceous or subshrub plants.

DISCUSSION

Fabaceae, Poaceae, Cyperaceae, Rubiaceae, and Euphorbiaceae are the most cited families in floristic surveys in Brazilian restingas (D.S.D. Araujo, personal communication). A checklist prepared by Zickel et al. (2007) for Pernambuco state likewise mentioned the high frequency of Fabaceae (67 spp.), Poaceae (39 spp.), Cyperaceae (26 spp.), and Euphorbiaceae (25 spp.). Santos-Filho et al. (2011) prepared a catalog for the state of Ceará in which Fabaceae (130 spp.), Cyperaceae (51), Poaceae (47), Rubiaceae (27), Euphorbiaceae (19), Asteraceae (13), Myrtaceae (12), and Bignoniaceae (11) were the families with the greatest number of species.

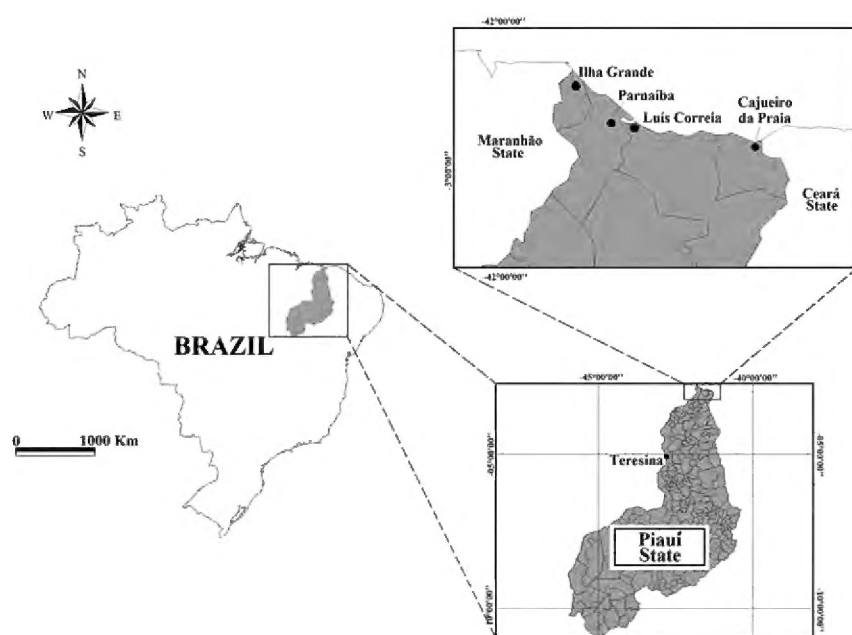


Figure 1. Map Piauí state, Brazil, along the Atlantic coast.

Table 1. List of phanerogamic species of restinga areas in Piauí state.

Family / Species	Habit	Voucher
Acanthaceae		
<i>Avicennia germinans</i> (L.) L.	Tree	HAF (458)
<i>Ruellia geminiflora</i> Kunth	Herb	HAF (2254)
<i>Ruellia paniculata</i> L.	Herb	TEPB (9350)
Aizoaceae		
<i>Sesuvium portulacastrum</i> (L.) L.	Herb	IPA (44758)
Alismataceae		
<i>Hydrocleys nymphoides</i> (Willd.) Buchenau	Herb	PEUFR (41887)
Amaranthaceae		
<i>Alternanthera brasiliana</i> (L.) Kuntze	Herb	HAF (971)
<i>Alternanthera littoralis</i> P. Beauv.	Herb	HAF (1067)
<i>Alternanthera littoralis</i> var. <i>maritima</i> (Mart.) Pedersen	Herb	HAF (90)
<i>Alternanthera paronychioides</i> A. St.-Hil.	Herb	HAF (100)
<i>Alternanthera regelii</i> (Seub.) Schinz	Herb	HAF (2302)
<i>Alternanthera sessilis</i> (L.) R. Br.	Herb	HAF (76)
<i>Amaranthus blitum</i> L.	Herb	TEPB (839)
<i>Amaranthus spinosus</i> L.	Herb	TEPB (9304)
<i>Amaranthus viridis</i> L.	Herb	TEPB (21305)
<i>Blutaparon portulacoides</i> (A. St.-Hil.) Mears	Herb	TEPB (615)
<i>Blutaparon vermiculare</i> (L.) Mears	Herb	TEPB (9343)
<i>Froelichia humboldtiana</i> Seub.	Herb	HST 14829
<i>Gomphrena demissa</i> Mart.	Herb	TEPB (19128)
Anacardiaceae		
<i>Anacardium occidentale</i> L.	Tree	HAF (950)
<i>Anacardium humile</i> A. St.-Hil.	Tree	TEPB (20403)
<i>Astronium fraxinifolium</i> Schott	Tree	TEPB (2154)
<i>Schinus terebinthifolius</i> Raddi	Tree	TEPB (10404)
Apocynaceae		
<i>Allamanda blanchetii</i> A. DC.	Shrub	HAF (86)
<i>Aspidosperma cuspa</i> (Kunth) Blake	Tree	HAF (1047)
<i>Aspidosperma pyrifolium</i> Mart.	Shrub	TEPB (3865)
<i>Calotropis procera</i> (Aiton) W.T. Aiton	Shrub	HAF (2529)
<i>Cryptostegia grandiflora</i> R. Br.	Shrub	TEPB (23433)
<i>Cryptostegia madagascariensis</i> Bojer	Shrub	HAF (1032)
<i>Hancornia speciosa</i> Gomes	Tree	TEPB (2549)
<i>Himatanthus drasticus</i> (Mart.) Plumel	Tree	TEPB (21918)
<i>Matelea maritima</i> (Vell.) Fontella	Vine	TEPB (17131)
<i>Schubertia grandiflora</i> Mart. & Zucc.	Vine	HST (14830)
<i>Tabernaemontana catharinensis</i> A. DC.	Subshrub	TEPB (2186)
<i>Tabernaemontana laeta</i> Mart.	Subshrub	HST (14831)
Araceae		
<i>Montrichardia linifera</i> (Arruda) Schott	Herb	IPA (65599)
<i>Pistia stratiotes</i> L.	Herb	IPA (61119)
<i>Taccarum peregrinum</i> (Schott) Engl.	Herb	TEPB (11639)
Arecaceae		
<i>Astrocaryum vulgare</i> Mart.	Tree	TEPB (24035)
<i>Attalea speciosa</i> Mart. ex Spreng.	Tree	TEPB (20528)
<i>Copernicia prunifera</i> (Mill.) H.E. Moore	Tree	TEPB (22220)
<i>Mauritia flexuosa</i> L. f.	Tree	HAF (2333)
Asteraceae		
<i>Elephantopus hirtiflorus</i> DC.	Herb	TEPB (17927)
<i>Chromolaena laevigata</i> (Lam.) R.M. King & H. Rob.	Shrub	IPA (63633)
<i>Mikania cordifolia</i> (L. f.) Willd.	Herb	TEPB (915)
<i>Pectis oligocephala</i> (Gardner) Sch. Bip.	Herb	TEPB (20613)
<i>Wedelia villosa</i> Gardner	Herb	TEPB (4115)
Bignoniaceae		
<i>Adenocalymma subsessilifolium</i> DC.	Vine	TEPB (27808)
<i>Amphilophium crucigerum</i> (L.) L. G. Lohmann	Vine	IPA (61307)
<i>Anemopaegma brevipes</i> S. Moore	Vine	TEPB (21640)

Family / Species	Habit	Voucher
<i>Anemopaegma parkeri</i> Sprague	Vine	PEUFR (51557)
<i>Cuspidaria argentea</i> (Wawra) Sandwith	Vine	TEPB (19771)
<i>Fridericia platyphylla</i> (Cham.) L. G. Lohmann	Vine	HST (19172)
<i>Handroanthus impetiginosus</i> (Mart. ex DC.) Mattos	Tree	HST (4348)
<i>Neojobertia candolleana</i> (Mart. ex DC.) Bureau & K.Schum.	Vine	TEPB (20112)
<i>Pleonotoma jasminifolia</i> (Kunth) Miers	Vine	HAF (484)
<i>Tabebuia aurea</i> (Silva Manso) Benth. & Hook. f. ex S. Moore	Tree	TEPB (18066)
<i>Tabebuia roseoalba</i> (Ridl.) Sandwith	Tree	IPA (59307)
Boraginaceae		
<i>Cordia rufescens</i> A. DC.	Tree	TEPB (11647)
<i>Euploca polyphylla</i> (Lehm.) J.I.M.Melo & Semir	Subshrub	IPA (86929)
<i>Heliotropium angiospermum</i> Murray	Subshrub	TEPB (3383)
<i>Heliotropium indicum</i> L.	Subshrub	TEPB (26577)
<i>Myriopus rubicundus</i> (Salzm. ex DC.) Luebert	Vine	IPA (65732)
<i>Tournefortia candidula</i> (Miers) I.M. Johnst.	Shrub	IPA (67421)
Bromeliaceae		
<i>Bromelia karatas</i> L.	Shrub	IPA (54807)
Burseraceae		
<i>Commiphora leptophloeos</i> (Mart.) J.B. Gillett	Tree	TEPB (9669)
Cabombaceae		
<i>Cabomba furcata</i> Schult. & Schult. f.	Herb	TEPB (10478)
Cactaceae		
<i>Cereus jamacaru</i> DC.	Shrub	TEPB (17298)
<i>Pilosocereus catingicola</i> subsp. <i>salvadorensis</i> (Werderm.) Zappi	Shrub	IPA (67007)
Cannabaceae		
<i>Celtis iguanaea</i> (Jacq.) Sarg.	Shrub	HST (14856)
Capparaceae		
<i>Cynophalla flexuosa</i> (L.) J. Presl	Tree	HAF (148)
<i>Cynophalla hastata</i> (Jacq.) J.Presl	Tree	IPA (85577)
Celastraceae		
<i>Maytenus distichophylla</i> Mart. ex Reissek (Figure 3A)	Shrub	TEPB (22777)
<i>Maytenus gonoclada</i> Mart.	Shrub	TEPB (27851)
Chrysobalanaceae		
<i>Chrysobalanus icaco</i> L.	Shrub	HAF (2254)
<i>Licania tomentosa</i> (Benth.) Fritsch	Tree	TEPB (27454)
Cleomaceae		
<i>Gynandropsis gynandra</i> (L.) Briq.	Shrub	HAF (2268)
<i>Tarenaya spinosa</i> (Jacq.) Raf.	Shrub	HAF (2321)
Clusiaceae		
<i>Platonia insignis</i> Mart.	Tree	HAF (2277)
Combretaceae		
<i>Combretum glaucocarpum</i> Mart.	Shrub	HAF (589)
<i>Combretum laxum</i> Jacq.	Shrub	HAF (770)
<i>Combretum leprosum</i> Mart.	Tree	HAF (157)
<i>Combretum mellifluum</i> Eichler	Shrub	HAF (60)
<i>Conocarpus erectus</i> L.	Shrub	HAF (2316)
Commelinaceae		
<i>Commelina erecta</i> L.	Herb	HAF (1136)
<i>Commelina obliqua</i> Vahl	Herb	HAF (2363)
Convolvulaceae		
<i>Cuscuta racemosa</i> Mart.	Vine	HAF (2315)
<i>Evolvulus ovatus</i> Fernald	Herb	HST (14834)
<i>Evolvulus pterocaulon</i> Moric.	Herb	HST (14828)
<i>Ipomoea asarifolia</i> (Desr.) Roem. & Schult.	Vine	HST (14833)
<i>Ipomoea carnea</i> subsp. <i>fistulosa</i> (Mart. ex Choisy) D.F.Austin	Vine	HAF (2390)
<i>Ipomoea pes-caprae</i> (L.) R. Br.	Vine	HAF (2366)

Continued

Table 1. Continued.

Family / Species	Habit	Voucher	Family / Species	Habit	Voucher
<i>Ipomoea procumbens</i> Mart. ex Choisy	Vine	HAF (175)	<i>Amburana cearensis</i> (Allemão) A.C. Sm.	Tree	TEPB (17260)
<i>Jacquemontia montana</i> (Moric.) Meisn.	Herb	HST (14904)	<i>Ancistrotropis peduncularis</i> (Kunth) A.Igado	Vine	TEPB (17045)
<i>Merremia aegyptia</i> (L.) Urb.	Vine	HAF (1701)	<i>Andira legalis</i> (Vell.) Toledo	Tree	PEUFR (10760)
<i>Operculina macrocarpa</i> (L.) Urb.	Vine	HST (14832)	<i>Andira nitida</i> Mart. ex Benth.	Tree	PEUFR (35870)
Cucurbitaceae			<i>Apuleia leiocarpa</i> (Vogel) J.F. Macbr.	Tree	TEPB (8016)
<i>Ceratosanthes palmata</i> (L.) Urb.	Vine	IPA (83307)	<i>Bauhinia acuruana</i> Moric.	Shrub	TEPB (27605)
<i>Luffa cylindrica</i> M. Roem.	Vine	HAF (49)	<i>Bauhinia dubia</i> G. Don	Shrub	TEPB (18152)
<i>Luffa operculata</i> (L.) Cogn.	Vine	TEPB (27240)	<i>Bauhinia forficata</i> Link	Shrub	TEPB (29086)
<i>Momordica charantia</i> L.	Vine	HAF (2472)	<i>Bauhinia unguolata</i> L.	Shrub	TEPB (26970)
Cyperaceae			<i>Calliandra fernandesii</i> Barneby	Subshrub	TEPB (13557)
<i>Bulbostylis capillaris</i> (L.) C.B. Clarke	Herb	TEPB (20271)	<i>Canavalia brasiliensis</i> Mart. ex Benth.	Vine	TEPB (8952)
<i>Bulbostylis scabra</i> (J. Presl & C. Presl) C.B. Clarke	Herb	TEPB (10216)	<i>Canavalia dictyota</i> Piper	Vine	PEUFR (37683)
<i>Cyperus aggregatus</i> (Willd.) Endl.	Herb	TEPB (10219)	<i>Centrosema brasilianum</i> (L.) Benth.	Vine	HAF (1218)
<i>Cyperus articulatus</i> L.	Herb	TEPB (9308)	<i>Centrosema rotundifolium</i> Mart. ex Benth.	Vine	TEPB (9793)
<i>Cyperus crassipes</i> Vahl	Herb	TEPB (27787)	<i>Chamaecrista desvauxii</i> (Collad.) Killip	Herb	IPA (12278)
<i>Cyperus ligularis</i> L.	Herb	TEPB (23258)	<i>Chamaecrista ensiformis</i> (Vell.) H.S. Irwin & Barneby	Shrub	IPA (29514)
<i>Eleocharis geniculata</i> (L.) Roem. & Schult.	Herb	TEPB (10275)	<i>Chamaecrista flexuosa</i> (L.) Greene	Subshrub	HAF (1976)
<i>Eleocharis interstincta</i> (Vahl) Roem. & Schult.	Herb	TEPB (27290)	<i>Chamaecrista hispidula</i> (Vahl) H.S. Irwin & Barneby	Herb	IPA (39901)
<i>Fimbristylis cymosa</i> R. Br.	Herb	TEPB (27307)	<i>Chamaecrista ramosa</i> (Vogel) H.S. Irwin & Barneby	Herb	IPA (40097)
<i>Kyllinga squamulata</i> Thonn. ex. Vahl	Herb	TEPB (9307)	<i>Chloroleucon acacioides</i> (Ducke) Barneby & J.W. Grimes	Tree	IPA (84407)
<i>Remirea maritima</i> Aubl.	Herb	TEPB (8554)	<i>Clitoria fairchildiana</i> R.A. Howard	Tree	HAF (2268)
<i>Rhynchospora riparia</i> (Nees) Boeckeler	Herb	TEPB (25740)	<i>Copaifera coriacea</i> Mart.	Shrub	TEPB (20874)
Dilleniaceae			<i>Copaifera langsdorffii</i> Desf.	Tree	TEPB (29128)
<i>Curatella americana</i> L.	Tree	HAF (1994)	<i>Copaifera luetzelburgii</i> Harms	Shrub	TEPB (27653)
<i>Davilla cearensis</i> Huber	Vine	RB (444275)	<i>Copaifera martii</i> Hayne	Shrub	TEPB (20691)
Dioscoreaceae			<i>Crotalaria incana</i> L.	Subshrub	HAF (2253)
<i>Dioscorea ovata</i> Vell.	Vine	TEPB (17679)	<i>Crotalaria mucronata</i> Desv.	Subshrub	PEUFR (25777)
Eriocaulaceae			<i>Crotalaria pallida</i> Aiton.	Subshrub	PEUFR (38798)
<i>Leiothrix rufula</i> (A. St.-Hil.) Ruhland	Herb	IPA (63663)	<i>Dalbergia ecastaphyllum</i> (L.) Taub.	Shrub	TEPB (21897)
Euphorbiaceae			<i>Desmodium glabrum</i> (Mill.) DC.	Subshrub	HAF (1282)
<i>Cnidoscolus urens</i> var. <i>neglectus</i> (Pohl) Lourteig	Shrub	PEUFR (41185)	<i>Dimorphandra gardneriana</i> Tul	Tree	TEPB (20669)
<i>Cnidoscolus urens</i> (L.) Arthur	Shrub	PEUFR (32496)	<i>Dioclea grandiflora</i> Mart. ex Benth.	Vine	HAF (1055)
<i>Croton adamantinus</i> Müll. Arg.	Shrub	HAF (1876)	<i>Dioclea reflexa</i> Hook. f.	Vine	IPA (906)
<i>Croton blanchetianus</i> Baill.	Shrub	HAF (1970)	<i>Dioclea violacea</i> Mart. ex Benth.	Vine	PEUFR (43874)
<i>Croton glandulosus</i> L.	Subshrub	HAF (1188)	<i>Enterolobium contortisiliquum</i> (Vell.) Morong	Tree	PEUFR (43923)
<i>Croton hirtus</i> L'Hér.	Subshrub	HAF (196)	<i>Erythrina velutina</i> Willd.	Tree	PEUFR (47973)
<i>Croton jacobinensis</i> Baill.	Subshrub	HAF (312)	<i>Galactia paraguariensis</i> Chodat & Hassl.	Vine	TEPB (23346)
<i>Croton pedicellatus</i> Kunth	Subshrub	HAF (747)	<i>Galactia striata</i> (Jacq.) Urb.	Vine	TEPB (22920)
<i>Dalechampia pernambucensis</i> Baill.	Vine	TEPB (10608)	<i>Hymenaea courbaril</i> L.	Tree	TEPB (20263)
<i>Dalechampia scandens</i> L.	Vine	HAF (746)	<i>Hymenaea stigonocarpa</i> Mart. ex Hayne	Tree	TEPB (20238)
<i>Euphorbia hirta</i> L.	Herb	HAF (205)	<i>Hymenaea velutina</i> Ducke	Tree	TEPB (20681)
<i>Euphorbia hyssopifolia</i> L.	Herb	HAF (1855)	<i>Indigofera microcarpa</i> Desv.	Subshrub	HAF (1486)
<i>Euphorbia tirucalli</i> L.	Shrub	TEPB (25436)	<i>Indigofera spicata</i> Forssk.	Subshrub	HST (14909)
<i>Jatropha mollissima</i> (Pohl) Baill.	Tree	TEPB (23022)	<i>Inga bahiensis</i> Benth.	Tree	HAF (2253)
<i>Manihot dichotoma</i> Ule	Tree	TEPB (10566)	<i>Inga vera</i> subsp. <i>affinis</i> (DC.) T.D. Penn.	Tree	TEPB (8901)
<i>Manihot carthaginensis</i> subsp. <i>glaziovii</i> (Müll. Arg.) Allem	Tree	TEPB (16829)	<i>Libidibia ferrea</i> (Mart. ex Tul.) L.P.Queiroz .	Tree	HAF (138)
<i>Manihot tristis</i> Mull. Arg.	Tree	TEPB (25906)	<i>Luetzelburgia auriculata</i> (Allemão) Ducke	Tree	TEPB (27032)
<i>Ricinus communis</i> L.	Tree	TEPB (25439)	<i>Machaerium acutifolium</i> Vogel	Tree	TEPB (8481)
<i>Tragia volubilis</i> L.	Vine	TEPB (21533)	<i>Machaerium inundatum</i> (Mart. ex Benth.) Ducke	Tree	TEPB (16767)
Fabaceae			<i>Machaerium lunatum</i> (L. f.) Ducke	Tree	TEPB (6078)
<i>Abrus precatorius</i> L. (Figure 3B)	Vine	HST (14901)	<i>Macroptilium atropurpureum</i> (Moc. & Sessé ex DC.) Urb.	Herb	IPA (45341)
<i>Aeschynomene brasiliana</i> (Poir) DC.	Subshrub	TEPB (5681)	<i>Macroptilium lathyroides</i> (L.) Urb.	Herb	HAF (58)
<i>Aeschynomene brevipes</i> Benth.	Subshrub	TEPB (17177)	<i>Macroptilium panduratum</i> (Benth.) Maréchal & Baudet	Herb	HAF (3303)
<i>Aeschynomene evenia</i> C.Wright & Sauvalle	Subshrub	HST (14910)	<i>Mimosa acutistipula</i> (Mart.) Benth.	Shrub	HAF (3134)
<i>Aeschynomene histrix</i> Poir.	Subshrub	HST (14933)	<i>Mimosa caesalpiniiifolia</i> Benth.	Shrub	HAF (1315)
<i>Aeschynomene paniculata</i> Willd. ex Vogel	Subshrub	TEPB (27640)			
<i>Aeschynomene sensitiva</i> Sw.	Shrub	TEPB (490)			
<i>Aeschynomene viscidula</i> Michx.	Subshrub	TEPB (848)			
<i>Albizia niopoides</i> (Spruce ex Benth.) Burkart	Shrub	HAF (2968)			
<i>Alysicarpus vaginalis</i> (L.) DC.	Herb	HST 14902			

Continued

Table 1. Continued.

Family / Species	Habit	Voucher
<i>Mimosa hirsutissima</i> Mart. (Figure 3C)	Shrub	HAF (1321)
<i>Mimosa invisa</i> Mart. ex Colla	Shrub	HAF (1425)
<i>Mimosa ophthalmocentra</i> Mart. ex Benth.	Shrub	HAF (1882)
<i>Mimosa pigra</i> L.	Shrub	HAF (1874)
<i>Mimosa pudica</i> L.	Shrub	HAF (527)
<i>Mimosa sensitiva</i> L.	Subshrub	HAF (2174)
<i>Mimosa tenuiflora</i> (Willd.) Poir.	Shrub	HAF (2178)
<i>Mimosa ursina</i> Mart.	Shrub	HAF (2216)
<i>Mimosa verrucosa</i> Benth.	Subshrub	HAF (2287)
<i>Mucuna urens</i> (L.) Medik.	Vine	TEPB (762)
<i>Neptunia oleracea</i> Lour.	Subshrub	TEPB (1834)
<i>Neptunia plena</i> (L.) Benth.	Subshrub	TEPB (23516)
<i>Parkia platycephala</i> Benth.	Tree	TEPB (25763)
<i>Parkinsonia aculeata</i> L.	Tree	TEPB (23516)
<i>Peltogyne confertiflora</i> (Mart. ex Hayne) Benth.	Shrub	TEPB (18557)
<i>Pityrocarpa moniliformis</i> (Benth.) Luckow & R.W.Jobson (Figure 3D)	Shrub	HST (14911)
<i>Piptadenia stipulacea</i> (Benth.) Ducke	Shrub	HAF (2132)
<i>Pithecellobium longiflorum</i> (Humb. & Bonpl. ex Willd.) Standl.	Shrub	TEPB (2552)
<i>Pityrocarpa obliqua</i> (Pers.) Brenan	Shrub	HAF (2770)
<i>Platypodium elegans</i> Vogel	Tree	HAF (2480)
<i>Poincianella bracteosa</i> (Tul.) L.P.Queiroz	Tree	TEPB (27571)
<i>Poincianella pyramidalis</i> var. <i>diversifolia</i> (Benth.) L.P.Queiroz	Shrub	TEPB (24437)
<i>Pterocarpus rohrii</i> Vahl	Tree	HAF (1679)
<i>Senegalia polyphylla</i> (DC.) Britton & Rose	Shrub	TEPB (27475)
<i>Senna alata</i> (L.) Roxb.	Shrub	HAF (1045)
<i>Senna gardneri</i> (Benth.) H.S. Irwin & Barneby	Shrub	TEPB (21408)
<i>Senna latifolia</i> (G. Mey.) H.S. Irwin & Barneby	Shrub	HAF (2355)
<i>Senna obtusifolia</i> (L.) H.S. Irwin & Barneby	Herb	HST (15843)
<i>Senna occidentalis</i> (L.) Link	Shrub	HAF (2362)
<i>Senna splendida</i> (Vogel) H.S. Irwin & Barneby	Shrub	HAF (2435)
<i>Senna trachypus</i> (Benth.) H.S. Irwin & Barneby	Shrub	HAF (130)
<i>Sesbania exasperata</i> Kunth	Herb	TEPB (9653)
<i>Stryphnodendron coriaceum</i> Benth.	Tree	TEPB (18108)
<i>Stylosanthes angustifolia</i> Vogel	Subshrub	TEPB (22035)
<i>Stylosanthes guianensis</i> (Aubl.) Sw.	Subshrub	HAF (1919)
<i>Stylosanthes humilis</i> Kunth	Subshrub	TEPB (9398)
<i>Swartzia flaemingii</i> Raddi	Tree	TEPB (22968)
<i>Tachigali vulgaris</i> L.F. Gomes da Silva & H.C. Lima	Tree	TEPB (27554)
<i>Tephrosia cinerea</i> (L.) Pers.	Subshrub	TEPB (6554)
<i>Tephrosia purpurea</i> (L.) Pers.	Subshrub	TEPB (1514)
<i>Vachellia farnesiana</i> (L.) Wight & Arn.	Shrub	TEPB (9907)
<i>Vatairea macrocarpa</i> (Benth.) Ducke	Tree	TEPB (5584)
<i>Zornia sericea</i> Moric.	Herb	TEPB (11001)
Krameriaceae		
<i>Krameria tomentosa</i> A. St.-Hil.	Shrub	HAF (470)
Lamiaceae		
<i>Amasonia campestris</i> (Aubl.) Moldenke	Subshrub	TEPB (23229)
<i>Leonotis nepetifolia</i> (L.) R. Br.	Shrub	TEPB (18838)
<i>Marsypianthes chamaedrys</i> (Vahl) Kuntze	Herb	TEPB (11109)
<i>Mesosphaerum pectinatum</i> (L.) Kuntze	Herb	TEPB (22295)
<i>Mesosphaerum suaveolens</i> (L.) Kuntze	Herb	TEPB (26961)
Lauraceae		
<i>Cassytha filiformis</i> L.	Hemiparasite	TEPB (27335)
Lecythidaceae		
<i>Lecythis pisonis</i> Cambess.	Tree	TEPB (20512)
Lentibulariaceae		
<i>Genlisea violacea</i> A. St.-Hil.	Herb	TEPB (22836)

Family / Species	Habit	Voucher
Loganiaceae		
<i>Spigelia anthelmia</i> L.	Herb	TEPB (22749)
Loranthaceae		
<i>Psittacanthus robustus</i> (Mart.) Mart.	Hemiparasite	TEPB (22559)
<i>Struthanthus flexicaulis</i> (Mart. ex Schult. f.) Mart.	Hemiparasite	TEPB (24892)
Lythraceae		
<i>Crenea maritima</i> Aubl.	Herb	HAF (2321)
<i>Cuphea flava</i> Spreng.	Herb	TEPB (13575)
Malpighiaceae		
<i>Byrsonima crassifolia</i> (L.) Kunth	Shrub	HAF (2263)
<i>Byrsonima gardneriana</i> A. Juss.	Shrub	HAF (2264)
<i>Byrsonima intermedia</i> A. Juss.	Shrub	HAF (2319)
<i>Byrsonima orbignyana</i> A. Juss.	Shrub	HAF (2223)
<i>Byrsonima verbascifolia</i> (L.) DC. (Figure 3E)	Shrub	HAF (2248)
<i>Diplopterys lutea</i> (Griseb.) W.R. Anderson & C. Davis (Figure 3F)	Vine	TEPB (23948)
<i>Stigmaphyllon bannisterioides</i> (L.) C.E. Anderson	Subshrub	PEUFR (25221)
<i>Stigmaphyllon paralias</i> A. Juss.	Subshrub	PEUFR (36443)
Malvaceae		
<i>Apeiba tibourbou</i> Aubl.	Tree	TEPB (28674)
<i>Byttneria divaricata</i> Benth.	Shrub	TEPB (23531)
<i>Byttneria filipes</i> Mart. ex K. Schum.	Shrub	IPA (28066)
<i>Helicteres muscosa</i> Mart.	Shrub	HAF (2516)
<i>Helicteres pentandra</i> L.	Shrub	HAF (341)
<i>Pachira aquatica</i> Aubl.	Tree	TEPB (8203)
<i>Sida ciliaris</i> L.	Herb	HAF (2053)
<i>Sida linifolia</i> Cav.	Herb	HAF (1311)
<i>Sterculia striata</i> A. St.-Hil. & Naudin	Tree	HAF (781)
<i>Waltheria americana</i> L.	Subshrub	HAF (1410)
<i>Waltheria viscosissima</i> A. St.-Hil.	Subshrub	HAF (1605)
Melastomataceae		
<i>Mouriri guianensis</i> Aubl.	Shrub	TEPB (27237)
<i>Mouriri pusa</i> Gardner	Shrub	HAF (2549)
<i>Pterolepis glomerata</i> (Rottb.) Miq.	Herb	TEPB (26612)
Meliaceae		
<i>Cedrela odorata</i> L.	Tree	TEPB (21936)
Menyanthaceae		
<i>Nymphoides indica</i> (L.) Kuntze	Herb	TEPB (27283)
Molluginaceae		
<i>Mollugo verticillata</i> L.	Herb	TEPB (10995)
Moraceae		
<i>Ficus gomelleira</i> Kunth & C.D. Bouché	Tree	TEPB (27047)
<i>Maclura tinctoria</i> (L.) D. Don ex Steud.	Tree	IPA (80908)
Myrtaceae		
<i>Campomanesia aromatica</i> (Aubl.) Griseb.	Shrub	TEPB (28705)
<i>Eugenia excelsa</i> O. Berg	Shrub	HAF (657)
<i>Eugenia puniceifolia</i> (Kunth.) DC. (Figure 3G)	Shrub	TEPB (24760)
<i>Eugenia stictopetala</i> Mart. ex DC.	Shrub	IPA (52931)
<i>Myrcia guianensis</i> (Aubl.) DC.	Shrub	HAF (658)
<i>Myrcia multiflora</i> (Lam.) DC.	Tree	HAF (763)
<i>Myrcia splendens</i> (Sw.) DC.	Shrub	HAF (1329)
<i>Myrciaria cuspidata</i> O.Berg	Shrub	TEPB (27829)
Nymphaeaceae		
<i>Nymphaea ampla</i> (Salisb.) DC.	Herb	TEPB (27280)
Nyctaginaceae		
<i>Boerhavia coccinea</i> Mill.	Herb	TEPB (27841)
Ochnaceae		
<i>Ouratea fieldingiana</i> (Gardner) Engl. (Figure 3H)	Shrub	HAF (2506)

Continued

Table 1. Continued.

Family / Species	Habit	Voucher
Olacaceae		
<i>Ximenia americana</i> L.	Shrub	HAF (720)
Onagraceae		
<i>Ludwigia hyssopifolia</i> (G. Don) Exell.	Herb	HAF (662)
Passifloraceae		
<i>Passiflora cincinnata</i> Mast.	Vine	TEPB (22001)
<i>Passiflora foetida</i> L.	Vine	HST (14905)
<i>Passiflora mucronata</i> Lam.	Vine	HAF (2378)
<i>Passiflora rubra</i> L.	Vine	HAF (1353)
Plantaginaceae		
<i>Scoparia dulcis</i> L.	Herb	TEPB (27977)
Plumbaginaceae		
<i>Plumbago scandens</i> L.	Subshrub	TEPB (27833)
Poaceae		
<i>Aristida setifolia</i> Kunth	Herb	TEPB (21873)
<i>Dactyloctenium aegyptium</i> (L.) Willd.	Herb	TEPB (27779)
<i>Digitaria nuda</i> Schumach.	Herb	TEPB (9942)
<i>Eleusine indica</i> (L.) Gaertn.	Herb	TEPB (9954)
<i>Paspalum maritimum</i> Trin.	Herb	TEPB (27772)
<i>Paspalum scutatum</i> Nees ex Trin.	Herb	IPA (86422)
<i>Spartina alterniflora</i> Loisel.	Herb	HAF (3145)
<i>Sporobolus virginicus</i> (L.) Kunth	Herb	IPA (23379)
<i>Steinchisma hians</i> (Elliott) Nash	Herb	HAF (1113)
<i>Streptostachys asperifolia</i> Desv.	Herb	IPA (73705)
<i>Urochloa fusca</i> (Sw.) B.F. Hansen & Wunderlin	Herb	IPA (60376)
Polygalaceae		
<i>Asemeia monticola</i> (Kunth) J.F.B.Pastore & J.R.Abbott	Herb	IPA (74241)
<i>Asemeia violacea</i> (Aubl.) J.F.B.Pastore & J.R.Abbott	Herb	IPA (43036)
<i>Polygala lycopodioides</i> Chodat	Herb	IPA (44678)
Polygonaceae		
<i>Coccoloba ramosissima</i> Wedd.	Shrub	TEPB (27542)
<i>Triplaris gardneriana</i> Wedd.	Tree	TEPB (29001)
Pontederiaceae		
<i>Eichornia crassipes</i> (Mart.) Solius	Herb	TEPB (22803)
<i>Pontederia cordata</i> L.	Herb	TEPB (22778)
Portulacaceae		
<i>Portulaca oleracea</i> L.	Herb	TEPB (20753)
<i>Portulaca umbraticola</i> Kunth	Herb	IPA (65218)
Rhamnaceae		
<i>Ziziphus joazeiro</i> Mart.	Tree	TEPB (24709)
Rubiaceae		
<i>Borreria verticillata</i> (L.) G. Mey.	Herb	TEPB (27304)
<i>Borreria spinosa</i> Cham. & Schltdl.	Herb	TEPB (24767)
<i>Chiococca alba</i> (L.) Hitchc. (Figure 3I)	Shrub	IPA (26228)
<i>Coutarea hexandra</i> (Jacq.) K. Schum.	Shrub	IPA (48092)
<i>Diodella apiculata</i> (Willd. ex Roem. & Schult.) Delprete	Herb	TEPB (28203)
<i>Genipa americana</i> L.	Tree	TEPB (29647)

Family / Species	Habit	Voucher
<i>Guettarda angelica</i> Mart. ex Müll.Arg.	Shrub	TEPB (23051)
<i>Guettarda platypoda</i> DC.	Shrub	TEPB (28588)
<i>Randia armata</i> (Sw.) DC.	Herb	TEPB (16913)
<i>Richardia grandiflora</i> (Cham. & Schltdl.) Steud.	Herb	HAF (1066)
<i>Staelia virgata</i> (Link ex Roem. & Schult.) K.Schum.	Subshrub	HAF (624)
<i>Tocoyena sellowiana</i> (Cham. & Schltdl.) K.Schum	Tree	HAF (1311)
Rutaceae		
<i>Pilocarpus microphyllus</i> Stapf ex Wardleworth	Tree	IPA (75564)
Santalaceae		
<i>Phoradendron constrictum</i> Griseb.	Hemiparasite	IPA (84835)
Sapindaceae		
<i>Cardiospermum corindum</i> L.	Vine	IPA (40689)
<i>Dodonaea viscosa</i> Jacq.	Vine	IPA (40701)
<i>Magonia pubescens</i> A. St.-Hil.	Tree	HAF (830)
<i>Urvillea stipitata</i> Radlk.	Vine	IPA (48711)
Sapotaceae		
<i>Manilkara cavalcantei</i> Pires & W.A. Rodrigues ex T.D. Penn.	Tree	UEC (97106)
<i>Manilkara salzmännii</i> (A. DC.) H. J. Lam	Tree	IPA (86359)
<i>Manilkara triflora</i> (Allemão) Monach.	Shrub	RB (444274)
Simaroubaceae		
<i>Simarouba versicolor</i> A. St.-Hil.	Tree	HAF (749)
Solanaceae		
<i>Datura stramonium</i> L.	Subshrub	TEPB (18244)
<i>Physalis angulata</i> L.	Herb	HAF (2394)
<i>Solanum crinitum</i> Lam.	Shrub	HAF (1852)
<i>Solanum depauperatum</i> Dunal	Shrub	HAF (1879)
<i>Solanum paludosum</i> Moric.	Shrub	HAF (1848)
<i>Solanum rhytidoandrum</i> Sendtn.	Shrub	HAF (1976)
Turneraceae		
<i>Turnera serrata</i> Vell.	Herb	HAF (787)
<i>Turnera subulata</i> Sm.	Herb	HAF (933)
<i>Turnera ulmifolia</i> L.	Herb	HAF (1427)
Typhaceae		
<i>Typha domingensis</i> Pers.	Herb	IPA (61868)
Verbenaceae		
<i>Lantana camara</i> L.	Shrub	HAF (1443)
<i>Lippia alba</i> (Mill.) N.E. Br. ex P. Wilson	Herb	HAF (664)
<i>Stachytarpheta sessilis</i> Moldenke	Herb	HAF (1071)
Violaceae		
<i>Pombalia calceolaria</i> (L.) Paula-Souza	Herb	HAF (353)
Vitaceae		
<i>Cissus erosa</i> Rich.	Vine	HAF (1070)
<i>Cissus verticillata</i> (L.) Nicolson & C.E. Jarvis	Vine	HAF (354)
Vochysiaceae		
<i>Qualea grandiflora</i> Mart.	Tree	HAF (759)
<i>Qualea parviflora</i> Mart.	Tree	HAF (680)

In a recent floristic survey performed in Piauí state that included part of the upper Northeastern coast (Santos-Filho et al. 2013), the Fabaceae, Poaceae, Cyperaceae, and Euphorbiaceae were found to have the highest number of species. These same families together with the Orchidaceae, Bromeliaceae, and Sapotaceae (Araújo and Henriques 1984; Assis et al. 2004; Martins et al. 2008) are well represented in restinga areas in Southeastern Brazil.

In general, the composition of species observed along the coast of Northeast Brazil resembles the one at the Cerrado and Caatinga. The influence of these biomes on

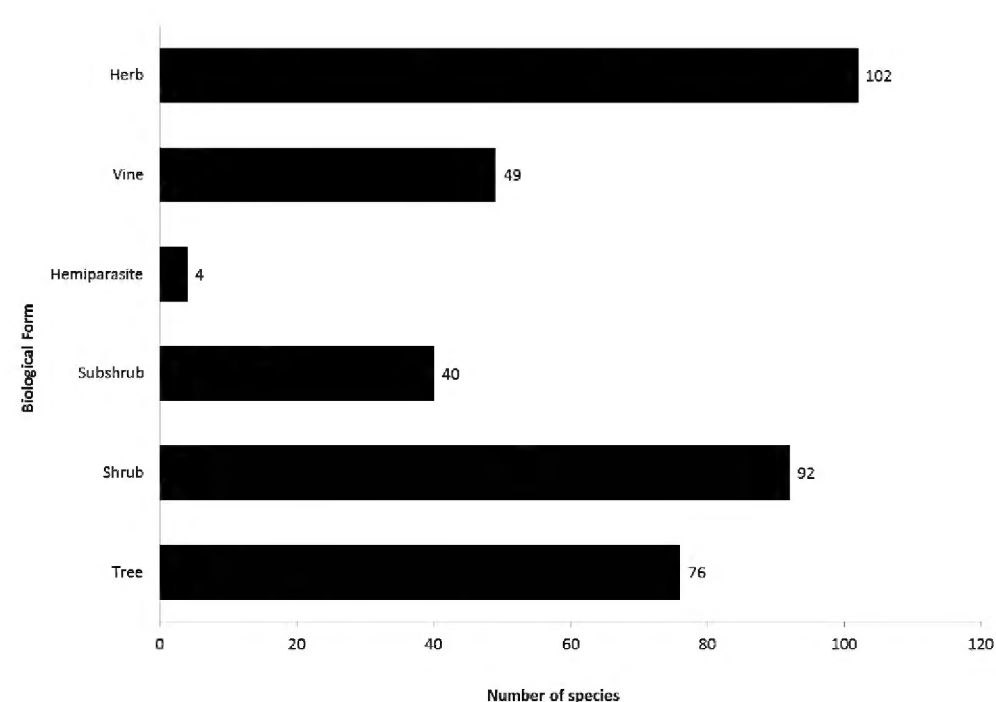


Figure 2. Distribution of the number of species in relation to the biological form of the species listed in the coastal areas of Piauí state, Brazil.

the species composition of restingas in the Northeast was also confirmed for the coast of Piauí, in which 48 species (13% of species surveyed in this study) were previously cited in other floristic studies carried in Cerrado and Caatinga areas of this state (Lemos and Rodal 2002; Lemos 2004; Chaves et al. 2007; Castro et al. 2007; Mesquita and Castro 2007; Castro et al. 2009; Mendes and Castro 2010; Oliveira et al. 2011; Pessoa and Santos-Filho 2011). Among the woody species, *Allamanda blanchetii*, *Cordia rufescens*, *Croton blanchetianus*, *Jatropha molissima*, *Copaifera luetzelburgii*, *Copaifera martii*, *Piptadenia moniliformis* were notable, and *Borreria spinosa*, *Marsypianthes chamaedrys*, *Pectis oligocephala*, and *Zornia sericea* were prominent among herbaceous species.

In addition, nine species belonging to the Amazon Domain were recorded and are specific to the conditions of the ecotonal state of Piauí. These species represent 2.5% of the species in this survey and include *Byttneria divaricata*, *Crenea maritima*, *Helicteres pentandra*, *Machaerium inundatum*, *Machaerium lunatum*, *Manihot tristis*, *Manilkara cavalcantei*, *Pachira aquatica*, and *Pilocarpus microphyllus* (Table 1). Among the species cited, it is noteworthy that *Manilkara cavalcantei* was first recorded on the coast of Piauí state by Almeida Jr. et al. (2011). This fact demonstrates the importance of conserving the remaining restingas, since *Manilkara cavalcantei*

figures in the list of endangered species (IUCN 2012).

Among the species listed, 37% were the first records in the state of Piauí, including *Anemopaegma brevipes*, *Cereus jamacaru*, *Maytenus distichophylla*, *Commelina erecta*, *Andira nitida*, *Cuphea flava*, *Byrsonima verbascifolia*, and *Chiococca alba*. This percentage is due primarily to the low record samples (Almeida Jr. et al. 2012) and scarcity of studies in the Northern coastal restinga (Santos-Filho and Zickel 2013), which indicates the importance of not only further floristic but also taxonomic and ecological studies.

The species composition observed were reflections of not only the peculiarities of the restinga ecosystem (with high salinity and low levels of soil nutrients among others) but also environmental degradation (Santos-Filho et al. 2011). *Blutaparon portulacoides*, *Chamaecrista flexuosa*, *Ipomoea asarifolia*, *Ipomoea pes-caprae*, *Mollugo verticillata*, *Remirea maritima*, *Richardia grandiflora* and *Sesuvium portulacastrum* (in addition to many members of the Fabaceae, Poaceae and Cyperaceae families) are among the most common plants in dune areas and restingas in Ceará (Matias and Nunes 2001; Santos-Filho et al. 2011), Rio Grande do Norte (Almeida Jr. et al. 2006; Almeida Jr. and Zickel 2009), and Pernambuco states (Zickel et al. 2007; Silva et al. 2008, Almeida Jr. et al. 2009; Cantarelli et al. 2012).

In comparison with other surveys of restingas in Northeastern Brazil (Maranhão [Cabral-Freire and Monteiro 1993]; Ceará [Matias and Nunes 2001; Santos-Filho et al. 2011; Castro et al. 2012]; Rio Grande do Norte [Freire 1990; Almeida Jr. et al. 2006; Almeida Jr. and Zickel 2009]; Paraíba [Carvalho and Oliveira-Filho 1993; Oliveira-Filho and Carvalho 1993; Pontes and Barbosa 2008]; Pernambuco [Andrade-Lima 1951, 1960, 1979; Leite and Andrade 2004; Almeida Jr. et al. 2007; Sacramento et al. 2007; Silva et al. 2008; Almeida Jr. et al. 2009]; Alagoas [Esteves 1980]; and Bahia [Pinto et al. 1984, Viana et al. 2006, Queiroz 2007, Menezes et al. 2012, Queiroz et al. 2012]), 85.2% of the species listed for Piauí were also reported in other coastal areas of Northeastern Brazil, and the remaining 14.8% were recorded only in the restingas in Piauí (including *Anacardium humile*, *Attalea speciosa*, *Bromelia karatas*, *Pilosocereus catingicola*, *Platonia insignis* and *Ruellia paniculata*) (Table 1). Despite the fact that these species occur in many other restinga areas, specific localities tend to have their own floras due to environmental factors that influence species composition (Barros 2009), particularly under the influence of surrounding ecosystems.

As the biological forms, the results reflects the significant presence of pioneer species that rapidly colonize this environment, mainly dune areas typical of the coast of the state of Piauí, which is similar to that found for the state of Ceará (Santos-Filho et al. 2011) with low open physiognomies of erect herbaceous species and vine-psammophytes.

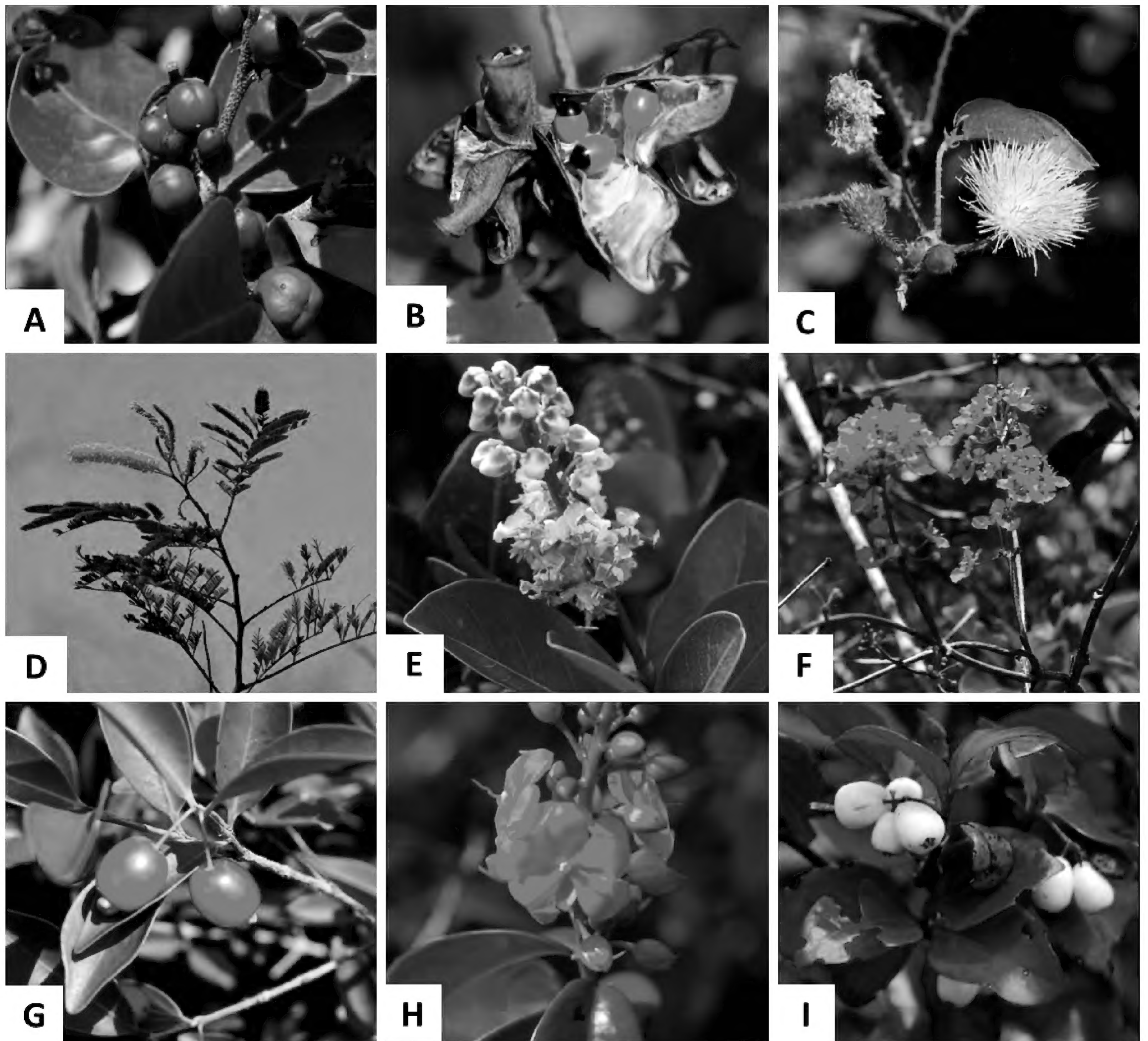


Figure 3. Flowers and fruits of species from the restingas of Piauí state, Brazil. A- *Maytenus distichophylla* Mart. ex Reissek; B- *Abrus precatorius* L.; C- *Mimosa hirsutissima* Mart.; D- *Pityrocarpa moniliformis* (Benth.) Luckow & R.W.Jobson; E- *Byrsonima verbascifolia* (L.) DC.; F- *Diplopterys lutea* (Griseb.) W.R. Anderson & C. Davis; G- *Eugenia punicifolia* (Kunth.) DC.; H- *Ouratea fieldingiana* (Gardner) Engl.; I- *Chiococca alba* (L.) Hitchc. (Photos: F.S. Santos-Filho)

The data presented here indicate the importance of herbaceous species in the physiognomic composition of beach areas. However, as occurs in other coastal areas of Northeastern Brazil (Silva *et al.* 2008; Almeida Jr. *et al.* 2009; Santos-Filho *et al.* 2011; Cantarelli *et al.* 2012), it is quite possible that due to their immediate proximity to the ocean, the restinga areas of Piauí state have been widely altered due to human activity, namely leisure and tourism. Therefore, conservation efforts focusing on these coastal vegetation communities must include quantitative studies and attempt to decelerate anthropogenic impact.

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LITERATURE CITED

- Almeida Jr., E.B., C.S. Zickel and R.M.M. Pimentel. 2006. Caracterização e espectro biológico da vegetação do litoral arenoso do Rio Grande do Norte. *Revista de Geografia* 23(3): 45–58. <http://www.revista.ufpe.br/revistageografia/index.php/revista/article/view/81/40>
- Almeida Jr., E.B., R.M.M. Pimentel and C.S. Zickel. 2007. Flora e formas de vida em uma área de restinga no litoral norte de Pernambuco, Brasil. *Revista de Geografia* 24(1): 19–34. <http://www.revista.ufpe.br/revistageografia/index.php/revista/article/view/110/51>

- Almeida Jr., E.B., M.A. Olivo, E.L. Araújo and C.S. Zickel. 2009. Caracterização da vegetação de restinga da RPPN de Maracaípe, Pernambuco, com base na fisionomia, flora, nutrientes do solo e lençol freático. *Acta Botanica Brasilica* 23(1): 36–48. doi: 10.1590/S0102-33062009000100005
- Almeida Jr., E.B. and C.S. Zickel. 2009. Fisionomia psamófila-reptante: riqueza de espécies na praia da pipa, Rio Grande do Norte, Brasil. *Pesquisas, Botânica* 60: 289–299. <http://www.anchietano.unisinos.br/publicacoes/botanica/botanica60/artigo2.pdf>
- Almeida Jr., E.B., F.S. Santos-Filho and C.S. Zickel. 2011. Magnoliophyta, Ericales, Sapotaceae, *Manilkara cavalcantei* Pires and Rodrigues ex T.D. Penn: First occurrence for northeastern Brazil. *Check List* 7(1): 53–54. <http://www.checklist.org.br/getpdf?NGD123-10>
- Almeida Jr., E.B., F.S. Santos-Filho and C.S. Zickel. 2012. Conserving species of the *Manilkara* spp. Threatened with extinction in vegetation fragments in Ecotone zones. *International Journal of Biodiversity and Conservation* 4(3): 113–117. doi: 10.5897/IJBC11.103
- Andrade-Lima, D. 1951. A Flora da Praia de Boa Viagem (1ª contribuição). *Boletim da Secretaria de Agricultura de Pernambuco* 18(1/2): 121–125.
- Andrade-Lima, D. 1960. Estudos fitogeográficos de Pernambuco. *Arquivos do Instituto de Pesquisas Agronômicas* 5: 305–341.
- Andrade-Lima, D. 1979. A flora e a vegetação da área Janga-Maranguape/Paulista—Pernambuco; pp. 179–190, in: *Anais do XXX Congresso Nacional de Botânica*. Sociedade Botânica do Brasil, Campo Grande, São Paulo, HUCITEC.
- APG III. 2009. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. *Botanical Journal of the Linnean Society* 161: 105–121. doi: 10.1111/j.1095-8339.2009.00996.x
- Araújo, D.S.D. 2000. Análise florística e fitogeográfica das restingas do Estado do Rio de Janeiro [Ph.D. Dissertation]. Rio de Janeiro: Universidade Federal do Rio de Janeiro. 189 pp.
- Araújo, D.S.D., R.P.B. Henriques. 1984. Análise florística das restingas do estado do Rio de Janeiro; pp. 159–193, in: L.D. Lacerda, D.S.D. Araújo, R. Cerqueira, and B. Turcq. (orgs.). *Restingas: origem, estrutura e processos*. Niterói, RJ: CEUFF.
- Araújo, D.S.D., M.C.A. Pereira and M.C.P. Pimentel. 2004. Flora e Restinga de comunidades na restinga de Jurubatiba – Síntese dos conhecimentos com enfoque especial para a Formação Aberta de *Clusia*. pp. 59–76, in: C.F.D Rocha, F.A. Esteves, and F.R. Scarano. (orgs.). *Pesquisas de Longa Duração na Restinga de Jurubatiba—Ecologia, História Natural e Conservação*. São Carlos, SP: Ed. RiMa.
- Assis, A.M., L.D. Thomaz and O.J. Pereira. 2004. Florística de um trecho de floresta de restinga no município de Guarapari, Espírito Santo, Brasil. *Acta Botanica Brasilica* 18(1): 191–201. doi: 10.1590/S0102-33062004000100016
- Cabral-Freire, M.C.C. and R. Monteiro. 1993. Florística das praias da Ilha de São Luís, estado do Maranhão (Brasil): diversidade de espécies e suas ocorrências no litoral brasileiro. *Acta Amazonica* 23(2–3): 125–140. <https://acta.inpa.gov.br/fasciculos/23-3/PDF/v23n3ao3.pdf>
- Cantarelli, J.R.R., E.B. Almeida Jr., F.S. Santos-Filho and C.S. Zickel. 2012. Tipos fitofisionômicos e florística da restinga da APA de Guadalupe, Pernambuco, Brasil. *Insula* 41: 95–117. doi: 10.5007/2178-4574.2012n41p95
- Carvalho, D.A. and A.T. Oliveira-Filho. 1993. Avaliação da recomposição da cobertura vegetal de dunas de rejeito de mineração, em Mataraca/PB. *Acta Botanica Brasilica* 7(2): 107–117. doi: 10.1590/S0102-33061993000200006
- Castro, A.A.J.F., N.M.C.F. Castro, J. M. Costa, R.R.S. Farias, M.R.A. Mendes, R.S. Albino, J.S. Barros and M.E.A. Oliveira. 2007. Cerrados marginais do Nordeste e ecótonos associados. *Revista Brasileira de Biociências* 5(S1): 273–275. <http://www.ufrgs.br/seerbio/ojs/index.php/rbb/article/view/296/260>
- Castro, A.A.J.F., A.S.F. Castro, R.R.S. Farias, S.R. Sousa, N.M.C.F. Castro, C.G.B. Silva, M.R.A. Mendes, J.S. Barros and R. N. Lopes. 2009. Diversidade de espécies e de ecossistemas da vegetação remanescente da Serra Vermelha, Área de Chapada, municípios de Curimatá, Redenção do Gurguéia e Morro Cabeça no Tempo, Sudeste do Piauí. *Publicações Avulsas em Conservação de Ecossistemas* 23: 1–72. <http://conservacaodeecossistemas.blogspot.com.br/2013/04/publ-avulsas-conserv-ecossistemas-23-1.html>
- Castro, A.S., M.F. Moro and M.O.T. Menezes. 2012. O complexo vegetacional da zona litorânea do Ceará: Pecém, São Gonçalo do Amarante. *Acta Botanica Brasilica* 26(1): 108–124. doi: 10.1590/S0102-33062012000100013
- Chaves, E.M.F., R.F.M. Barros and F.S. Araújo. 2007. Flora Apícola do Carrasco no Município de Cocal, Piauí, Brasil. *Revista Brasileira de Biociências* 5(S1): 555–557. <http://www.ufrgs.br/seerbio/ojs/index.php/rbb/article/view/564/477>
- Esteves, G.L. 1980. Contribuição ao conhecimento da vegetação de restinga de Maceió – Alagoas. Recife: Secretaria de Planejamento do Estado de Alagoas. 80 pp.
- Farias, R.R.S. and A.A.J.F. Castro. 2004. Fitossociologia de trechos da vegetação do Complexo Campo Maior, PI, Brasil. *Acta Botanica Brasilica* 18(4): 949–963. doi: 10.1590/S0102-33062004000400025
- Fernandes, A.G., A.S. Lopes, E.V. Silva, G.M. Conceição and M.F.V. Araújo. 1996. IV – Componentes biológicos: Vegetação; pp. 43–72, in: CEPRO, Macrozoneamento Costeiro do Estado do Piauí: relatório geoambiental e sócio-econômico. Teresina: Fundação CEPRO.
- Freire, M.S.B. 1990. Levantamento florístico do Parque Estadual das Dunas do Natal. *Acta Botanica Brasilica* 4(2): 41–59. doi: 10.1590/S0102-33061990000300006
- Hay, J.D., L.D. Lacerda and A.L. Tan. 1981. Soil cation increase in a tropical sand dune ecosystem due to a terrestrial bromeliad. *Ecology* 62(5): 1392–1395. doi: 10.2307/1937303
- IUCN. (2012) The 2012 IUCN Red List of Threatened Species. Accessed at <http://www.redlist.org>, 7 December 2012.
- Lemos, J. R. 2004. Composição florística do Parque Nacional Serra da Capivara, Piauí, Brasil. *Rodriguesia* 55(85): 55–66. http://rodriguesia.jbrj.gov.br/FASCICULOS/Rodrig55_85/Jesus.pdf
- Lemos, J.R. and M.J.N. Rodal. 2002. Fitossociologia do componente lenhoso de um trecho da vegetação de caatinga no Parque Nacional Serra da Capivara, Piauí, Brasil. *Acta Botanica Brasilica* 16(1): 23–42. doi: 10.1590/S0102-33062002000100005
- Leite, A.V.L. and L.H.C. Andrade. 2004. Riqueza de espécies e composição florística em um ambiente de duna após 50 anos de pressão antrópica: um estudo na Praia de Boa Viagem, Recife, PE – Brasil. *Biotemas* 17(1): 29–46. <https://periodicos.ufsc.br/index.php/biotemas/article/view/23266/21000>
- Lista de Espécies da Flora do Brasil. 2014. Jardim Botânico do Rio de Janeiro. Accessed at <http://floradobrasil.jbrj.gov.br/>, 25 December 2014.
- Martins, S.E., L. Rossi, P.S.P. Sampaio and M.A.G. Magenta. 2008. Caracterização florística de comunidades vegetais de restinga em Bertioxa, SP, Brasil. *Acta Botanica Brasilica* 22(1): 249–274. doi: 10.1590/S0102-33062008000100024
- Mather, J.R. and G.A. Yoshioka. 1968. The role of climate in the distribution of vegetation. *Annals of the Association of American Geographers* 58(1): 29–41. doi: 10.1111/j.1467-8306.1968.tb01634.x
- Matias, L.Q. and E.P. Nunes. 2001. Levantamento florístico da área de proteção ambiental de Jericoacoara, Ceará. *Acta Botanica Brasilica* 15(1): 35–43. doi: 10.1590/S0102-33062001000100005
- Mendes, M. R. A., A.A.J.F. Castro. 2010. Vascular Flora of Semi-Arid

- Region, São José do Piauí, State of Piauí, Brazil. Check List 6(1): 039–044. <http://www.checklist.org.br/getpdf?SLO65-09>
- Menezes, C.M., F.D. Santana, V.S.A. Silva, V.I.S. Silva and D.S.D. Araujo. 2012. Florística e fitossociologia em um trecho de restinga do litoral norte do Estado da Bahia. *Biotemas* 25(1): 31–38. doi: 10.5007/2175-7925.2012v25n1p31
- Mesquita, M. R. and A.A.J.F. Castro. 2007. Florística e fitossociologia de uma área de cerrado marginal (Cerrado Baixo), Parque Nacional de Sete Cidades, Piauí. *Publicações Avulsas em Conservação de Ecossistemas* 15: 1–22. <http://conservacaodeecossistemas.blogspot.com.br/2013/04/mesquita-marcelo-ribeiro-castro-a.html>
- Oliveira, L.S.D., R.F.M. Barros, F.A.R. Soares, S.M.N.A. Soares and V. Rodrigues. 2011. Caracterização florística e fisionômica de uma área de Cerrado do Piauí, Brasil; pp. 103–134, in: F.S. Santos-Filho, and A.F.C.L. Soares (orgs.). *Biodiversidade do Piauí: pesquisas & perspectiva*. Curitiba, PR: Ed. CRV.
- Oliveira-Filho, A.T. and D.A. Carvalho. 1993. Florística e fisionomia da vegetação no extremo norte do litoral da Paraíba. *Revista Brasileira de Botânica* 16(1): 115–130.
- Pessoa, L.M. and F.S. Santos-Filho. 2011. Florística e estrutura do estrato herbáceo em cinco municípios no Estado do Piauí; pp. 103–134, in: F.S. Santos-Filho, and A.F.C.L. Soares (orgs.). *Biodiversidade do Piauí: pesquisas & perspectiva*. Curitiba, PR: Ed. CRV.
- Pinto, G.L.P., H.P. Bautista and J.D.C.A. Ferreira. 1984. A restinga do litoral nordeste do estado da Bahia; pp. 195–203, in: L.D. Lacerda, D.S.D. Araujo, R. Cerqueira, and B. Turq (eds.). *Restingas: origem, estrutura e processos*. Niterói: CEUFF.
- Pontes, A.F. and M.R.V. Barbosa. 2008. Floristic Survey of the AMEM Forest, Cabedelo, Paraíba, Brazil; pp. 458–473, in: W.W. Thomas, and E.G. Britton (eds.). *The atlantic coastal forest of Northeastern Brazil*. New York: The New York Botanical Garden.
- Queiroz, E.P. 2007. Levantamento florístico e georreferenciamento das espécies com potencial econômico e ecológico em restinga de Mata de São João, Bahia, Brasil. *Biotemas* 20(4): 41–47. <https://periodicos.ufsc.br/index.php/biotemas/article/view/20604/18792>
- Queiroz, E.P., D.B.O.S. Cardoso and M.H.S. Ferreira. 2012. Composição florística da vegetação de restinga da APA Rio Capivara, Litoral Norte da Bahia, Brasil. *Sitientibus, série Ciências Biológicas* 12(1): 66–73. doi: 10.13102/scb119
- Rizzini, C.T. 1997. *Tratado de fitogeografia do Brasil*. 2ª ed. Rio de Janeiro: Âmbito Cultural Ed. Ltda. 747 pp.
- Rocha, C.F.D., H.G. Bergallo, M.A.S. Alves and M. Van Sluys. 2004. A Restinga de Jurubatiba e a conservação dos ambientes de restinga do estado do Rio de Janeiro; pp. 341–352, in: C.F.D.; Rocha, F.A. Esteves and F.R. Scarano. *Pesquisas de longa duração na Restinga de Jurubatiba: ecologia, história natural e conservação*. São Carlos: RiMa.
- Rocha, C.F.D., H.G. Bergallo, M. Van Sluys, M.A.S. Alves and C.E. Jamel. 2007. The remnants of restinga habitats in the brazilian Atlantic Forest of Rio de Janeiro state, Brazil: habitat loss and risk of disappearance. *Brazilian Journal of Biology* 67(2): 263–273. doi: 10.1590/S1519-69842007000200011
- Sacramento, A.C.S., C.S. Zickel and E.B. Almeida Jr. 2007. Aspectos florísticos da vegetação de restinga no litoral de Pernambuco. *Revista Árvore* 31(6): 1121–1130. doi: 10.1590/S0100-67622007000600017
- Santos-Filho, F.S. 2009. *Composição florística e estrutural da vegetação de Restinga do Estado do Piauí* [Ph.D. Dissertation]. Recife: Universidade Federal Rural de Pernambuco. 111 pp.
- Santos-Filho, F.S., E.B. Almeida Jr., C.J.R.S. Soares and C.S. Zickel. 2010. Fisionomias das Restingas do Delta do Parnaíba, Nordeste, Brasil. *Revista Brasileira de Geografia* 3(3): 218–227. <http://www.revista.ufpe.br/rbgfe/index.php/revista/article/view/113/142>
- Santos-Filho, F.S., E.B. Almeida Jr., L.F.M. Bezerra, L.F. Lima and C.S. Zickel. 2011. Magnoliophyta, restinga vegetation, state of Ceará, Brazil. Check List 7(4): 478–485. <http://www.checklist.org.br/getpdf?SLO01-11>
- Santos-Filho, F.S., E.B. Almeida Jr. and C.S. Zickel. 2013. A flora das restingas de Parnaíba e Luiz Correia — litoral do Piauí, Brasil; pp. 37–60, in: F.S. Santos-Filho, A.F.C.L. Soares and E.B. Almeida Jr. (orgs.). *Biodiversidade do Piauí: pesquisas & perspectivas*. Vol. 2. Curitiba: CRV.
- Santos-Filho, F.S. and C.S. Zickel. 2013. Origem e estrutura da costa e sua vegetação de restinga: o caso do litoral do Piauí; pp. 11–36, in: F.S. Santos-Filho, A.F.C.L. Soares and E.B. Almeida Jr. (orgs.). *Biodiversidade do Piauí: pesquisas & perspectivas*. Vol. 2. Curitiba: CRV.
- Scarano, F.R. 2002. Structure, function and floristic relationships of plant communities in stressful habitats marginal to the Brazilian Atlantic rainforest. *Annals of Botany* 90: 517–524. doi: 10.1093/aob/mcf189
- Silva, J.M.C. and M. Tabarelli. 2000. Tree species impoverishment and the future flora of the Atlantic forest of northeast Brazil. *Nature* 404: 72–74. doi: 10.1038/35003563
- Silva, S.S.L., C.S. Zickel and L.A. Cestaro. 2008. Flora vascular e perfil fisionômico de uma restinga no litoral sul de Pernambuco. *Acta Botanica Brasilica* 22(4): 1123–1135. doi: 10.1590/S0102-33062008000400023
- Thiers, B. 2014. Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Accessed at <http://sweetgum.nybg.org/ih/>, 24 October 2014.
- Velloso, A.L., E.V.S.B. Sampaio and F.G.C. Pareyn. 2002. Ecorregiões propostas para o bioma Caatinga. Recife: Associação Plantas do Nordeste/The Nature Conservancy do Brasil. 76 pp. <http://www.plantasdonordeste.org/Livro/Index.htm>, 28 September 2009.
- Viana, B.F., F.O.S. Silva and A.M.P. Kleinert. 2006. A flora apícola de uma área restrita de dunas litorâneas, Abaeté, Salvador, Bahia. *Revista Brasileira de Botânica* 29(1): 13–25. doi: 10.1590/S0100-84042006000100003
- Whittaker, R.H. 1975. *Communities and ecosystems*. Vol. 2. MacMillan. New York. 385 pp.
- Zaluar, H.L.T. and Scarano, F.R. 2000. Facilitação em restingas de moitas: Um século de buscas por espécies focais; pp. 3–23, in: F.A. Esteves and L.D. Lacerda (eds.). *Ecologia de restingas e lagoas costeiras*. NUPEM/UFRJ, Rio de Janeiro.
- Zickel, C.S., E.B. Almeida Jr., D.P.W. Medeiros, P.B. Lima, T.M.S. Souza and A.B. Lima. 2007. Magnoliophyta species of restinga, state of Pernambuco, Brazil. Check List 3(3): 224–241. <http://www.checklist.org.br/getpdf?SLO13-07>

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